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CONTROL OF DISEASES AND INSECTS OF ONIONS

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CONTROL OF DISEASES AND INSECTS OF ONIONS

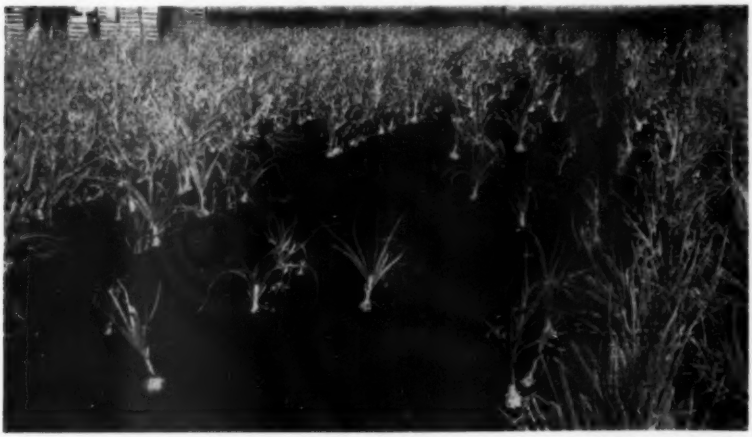
A. G. Newhall and W. A. Rawlins

Onion growing is the major segment of vegetable production on New York mucklands. For maximum yields the crop must be protected from diseases, insects and other pests that thin stands and injure the foliage. Control measures have been developed to reduce losses from these pests. In the following pages materials and methods are described to show how the pests that live in the soil and on the foliage may be controlled.

DISEASES AND INSECTS THAT COME FROM THE SOIL

Onion Smut (Urocystis cepulae)

Smut is a devastating seedling disease. None of the bulbing varieties are resistant in the seedling stage, but sets and transplants are immune. Continuous planting of onions on the same fields allows the fungus to become more serious in each succeeding crop. The fungus lives in the soil and may endure for many seasons without host plants. It is not seed-borne. Spores can be carried from field to field by



Where smut is abundant an untreated plot may melt away before harvest.

A badly smutted seedling six or seven weeks old.

water, by wind, and on the tools used for cultivation. The disease is worse in wet, cool spring weather.

As the onion seeds germinate the fungus penetrates into the cotyledons where it produces swollen, black pustules which rupture after 6 to 7 weeks releasing myriads of spores. These spores settle to the soil to perpetuate the fungus. Many of the infected seedlings die early; others linger to succumb during hot weather, and a few continue to live until late in the season. From the cotyledons the fungus may grow into the leaves causing them to twist and curl, the plants to be stunted and worthless.

Onion Maggot (Hylemya antiqua Meig.)

A dark grayish fly, somewhat smaller than the housefly, lays its tiny, white, elongated eggs near the onion plants. These eggs hatch into onion maggots, white, footless creatures that bore into the bases of the plants causing them to collapse and die. As a result, stands are thinned out or completely ruined. Experiments have shown that yields are reduced when 5 percent or more of the seedlings are killed.

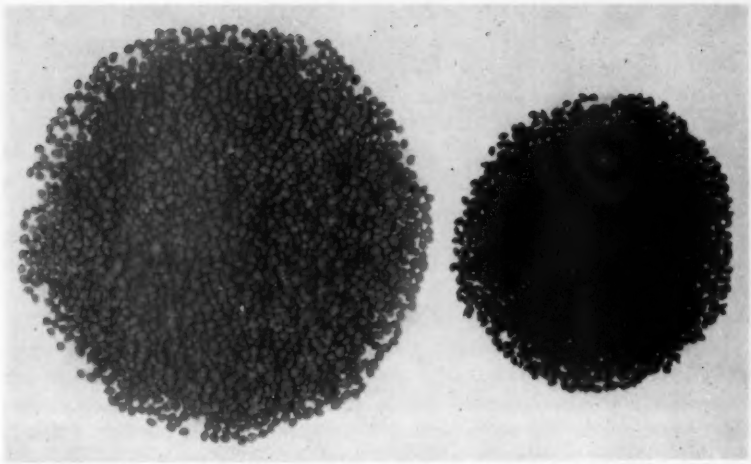
Egg laying takes place during May. Maggot injury is first noticed about June 15th and damage continues for 3 to 4 weeks. The spring generation of maggots is the most serious. In fact little consideration is given to the later generations which pass unnoticed in the field. Occasionally a mature bulb will show evidence of feeding by the second generation, but the injury is seldom extensive or serious. Hence, control measures are directed at the early infestation.

Control Measures for Smut and Maggots

Seed Treatment:

Seed pelleting with a fungicide-insecticide combination offers two-fold protection against smut and maggots. It is simple and convenient. Most seed treating is done for growers by seedmen and custom treaters. The preferred fungicides contain thiram, although captan is satisfactory in seasons

The life stages of the onion maggot, left to right, adult or fly, pupae, maggots.



Pelleted and untreated onion seed in equal numbers show why larger hole must be used in drill plate to sow pelleted seed.

when smut is not too severe. Recommended insecticides include the wettable powders of aldrin, dieldrin and heptachlor.

The first procedure in coating the seed is to prepare a sticker solution to bind the fungicide powder to the seed. This is done by dissolving 2 ounces (56 grams) of methyl cellulose (Methocel) in a quart (1000 ml.) of warm water. Mixed in this solution is an amount of insecticide determined by the content of chemical in the powder —2.5 ounces (70 grams) of a 75% concentrate or 3.5 ounces (100 grams) of a 50% strength. Three liquid ounces (105 ml.) of this mixture are needed to wet one pound of seed. Then to the wet mass is added the fungicide, a 75% seed treatment formulation, in weight equal to that of the dry seed.

Vigorous agitation is necessary to spread these materials evenly over the seeds. A tin can and a paint can

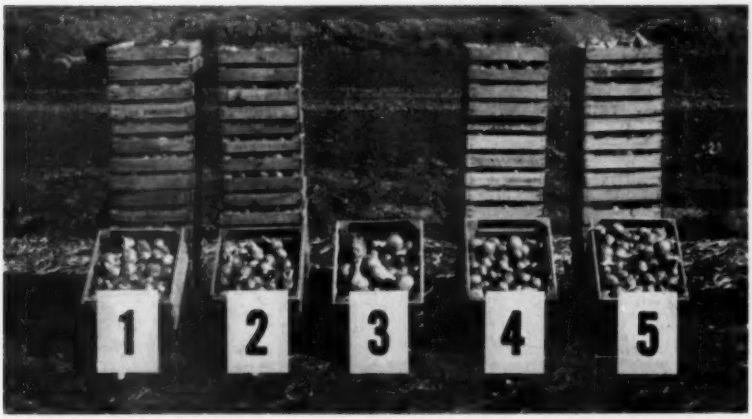
"Red Devil" paint can conditioner used to shake four pounds of seed at a time in the pelleting process.

shaker make a convenient apparatus for this procedure. A gallon container with a tight fitting friction lid holds 2 pounds of seeds, leaving enough room for individual seeds to bounce around during the shaking. Larger cans may be used for greater quantities of seed. The containers should not be overloaded; experience indicates that 4 pounds of seed is maximum for the largest container that will fit between the clamps of a paint shaker. Seeds are placed in the tin can, the sticker solution added, and the can is shaken for 2 minutes. Next, the fungicide is spread over the wet seeds and the can is shaken again for 5 minutes. The individual seeds should come out evenly coated. Clumping indicates an excess of sticker; considerable loose powder in the can shows that more sticker is needed. Treated seeds should be dried before storage.

In-the-furrow, Drip Treatment:

Another method of controlling smut and maggots is the injection of chemicals in the seed furrow during planting. A dilute solution of formaldehyde for smut control has been a standby for 30 years. More recently an emulsifiable insecticide formulation has been added to protect against maggots. This mixture is dribbled into the open furrow immediately behind the planter shoe at the rate of 100 to 150 gallons to the acre according to moisture conditions of the muck. The lower gallonage is used in wet muck and increased in the drier soils.

A modern 6-row seeder with two 50 gallon formaldehyde drums mounted over a roller. Elba, New York.



Yields from experimental plots show the value of controlling onion maggots by in-the-furrow drip treatment. Emulsifiable insecticide concentrate was added to a dilute solution of formaldehyde and dribbled into the seed furrow. 1 aldrin, 2 dieldrin, 3 no insecticide, 4 heptachlor, 5 parathion.

The quantity of solution to be applied per acre should contain one gallon of formaldehyde and one pint of an emulsifiable insecticide: aldrin, dieldrin, heptachlor or parathion. In a few tests liquid Vancide, ¾% solution, has given good smut control but the onion seedlings grow slowly for a few weeks. Dithane, 1%, is better.

The machinery used for this method consists of a tractor-drawn, 4 to 6 row gang seeder with tanks or large drums to hold the formaldehyde-insecticide solution mounted atop the seeder. The liquid is conveyed by ¼ inch copper piping and flexible tubing to the rear of the planter shoes where the streams of solution are directed into the open furrow and over the seeds. The liquid soaks into the furrow and protects the basal areas of the seedlings from smut and maggots.

In-the-furrow, Dust Teatment:

The injection of a liquid in the seed furrow requires a large quantity of water. Where transport of water to the field is a problem, blowing a combination dust into the seed furrow is another effective method of smut and maggot control. The dust, applied at 25 pounds per acre, is composed of 10% thiram and 2% insecticide: aldrin, dieldrin or heptachlor. The machinery required for application includes a tractor-mounted gang seeder and a self-powered duster unit. The dust is conducted by flexible tubes to the rear of the planter shoes and is blown into the open furrow around the seeds.

This method is attended with difficulties. The air blast must not be too strong or the seeds will be blown from the furrow. Perhaps the best way to

Schedule for the Control of Onion Diseases and Insects

	Pest Controlled	Type of Application	Materials	Amounts per Application	Remarks	For Further Details
Applications at planting time	Onion Smut and Onion maggot	Seed treatment	Thiram *or* Captan *plus* Aldrin *or* Dieldrin *or* Heptachlor	5 lbs to 5 lbs seed 1 oz. to 6 lbs seed	Sticker solution must be used to bind chemicals to the seed.	See pages 4 to 6
		Liquid in seed furrow	Formaldehyde *or* Dithane *plus* Emulsifiable insecticide concentrate	1 to 1½ gal per acre 1 pint	Dilute chemicals in 100 to 150 gallons water. Use the lower gallonage in wet soil.	See pages 6 and 7
		Dust blown in seed furrow	Thiram *or* Captan *plus* Aldrin *or* Dieldrin *or* Heptachlor	2.5 lbs per acre. ½ lb. per acre	Apply at rate of 25 lbs mixed dust per acre. Wear facial mask if necessary	See pages 7 and 8
		Dust mixed with dry seed	Thiram *or* Captan *plus* Dieldrin *or* Aldrin *or* Heptachlor	1 lb to 3 lbs seed 4 oz to 3 lbs seed	Chemicals should be mixed thoroughly before application to the dry seed.	

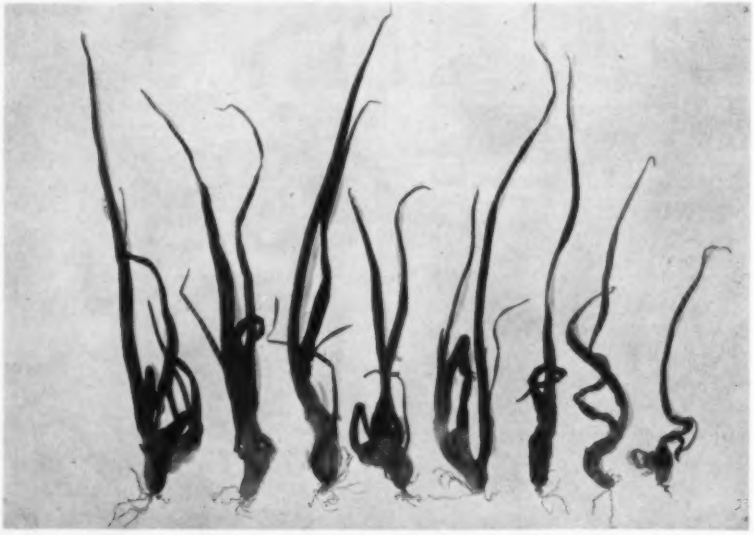
Foliage Applications	Blast Mildew	Sprays	Nabam + zinc sulphate *or* Maneb *or* Zineb *or* Captan *plus* DDT *or* Dieldrin *or* Heptachlor *or* Parathion	2 qts–¾ lb per acre 3 lbs per acre 3 lbs per acre 4 lbs per acre DDT 1½ lb actual others ½ lb actual per acre	Start applications when plants are 6 to 8 inches high Add wetting agent to sprays.	See page 16
	Thrips	Dusts	Zineb *plus* DDT *or* Dieldrin *or* Heptachlor *or* Parathion	8–10% fungicide 10% actual 2½% " 2½% " 1% "	Apply at rate of 35 to 50 lbs per acre. Late evening or early morning is best time for application	
Soil Fumigation	Bulb nematode (bloat)	Soil injection of fumigant materials	D-D mixture *or* Telone	50 gals per acre	Summer or Fall application previous to next onion crop. Soil temperature should be above 60°F. at time of treatment Do not use ethylene dibromide in fields to be planted to onions within 2 years	See pages 12 and 13
	Root-knot nematode		D-D mixture *or* Telone	40 gals per acre 32 gals per acre		
	Bulb Mites		D-D mixture *or* Telone	30-40 gals per acre		

reduce air speed at the ends of the tubes is to weld a short piece of pipe with a larger diameter to the end of each tube. The dust must be metered accurately, and not many dusters are positive in this respect. Delivery rates also vary with the composition and compactness of the dust. Careful calibration of the dust flow is necessary to insure an application sufficient for adequate control but not too wasteful. Continued attention must be given to dust delivery to be sure that the flow remains fairly constant.

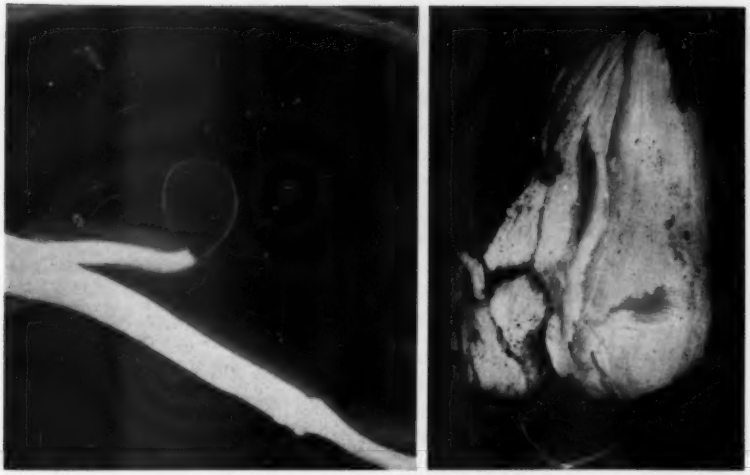
The foregoing applications have no practical value in suppressing nematodes and mites which are destructive in many onion fields. More and more growers are using volatile chemicals to fumigate the soil as a means to destroy these pests. The fumigant is injected into the muck with special applicators. The fumes released by the chemicals spread throughout the soil to a depth of several inches.

Bloat or Nematode Bulb Rot

This disease is caused by a microscopic nematode, *Ditylenchus dipsaci,* which invades the flesh of the onion causing the tissues to be spongy, hence the name "bloat." This nematode becomes active in the spring when the soil temperature reaches 60°F. It penetrates into the sprouts and seedlings, multiplies rapidly, and causes a swelling of the stem and a foreshortening and curling of the leaves. The bulbous parts or stems will become puffy and soft. Usually secondary



Bloat affects onions from the week in which they germinate until mid-summer (as shown) when hot weather often kills them.



Left: Diseased seedling enlarged in water shows the size of nematodes swimming around. Note seed is still attached. **Right:** A bulb filled with nemas. Note the light "frosy" appearance of infected scales.

bacteria and fungi rot the bulbs which often split open in a vertical plane. Normal stands in June may disappear by August.

Bulbs which become infected late in the growing season show a breaking of the scales from the basal plate. When the fleshy scales are broken crosswise, the tissues appear spongy, resembling the effects of frost. Diseased bulbs seldom survive the storage period, but a few do and if planted to obtain seed they may produce weak plants. Outbreaks of "bloat" in New York State have been traced in many cases to planting of infected set onions. In England the disease is occasionally seed-borne, but this happens rarely in the United States.

The nematodes can be carried in surface waters to be spread around during floods. They will be transported from areas where refuse from a diseased crop has been plowed under to new places in fields by tillage and cultivation implements: plows, harrows, cultivators. In these new locations the nematodes multiply rapidly and within 2 years the telltale barren spots appear as if lightning bolts had hit the field.

Root Knot Nematode:

Another nematode has been reducing yields in Elba and in Oswego and Orange counties by attacking seedling roots and causing them to become very crooked and to develop small swellings. The plants are stunted and pale and so produce smaller bulbs, sometimes with thick necks. This northern root-knot nematode, *Meloidogyne hapla,* can attack many vegetables and

weeds. It is a micrscopic eelworm that can probably go through its entire life cycle 2 or 3 times in one summer on the muck. Onions used to be considered resistant to root knot, but at least one strain of this nematode has become adapted to life in onion roots and is giving growers who do not rotate with immune crops much concern.

Mites

Tiny, spider-like creatures have been found feeding on the roots of seedling onions in localized areas of fields where the stands have thinned out. These mites have been identified as a species that is injurious to lily bulbs and gladioli, also. Although not a common pest, some muckland onions have been badly damaged.

The mites are smaller than the head of a pin, oval in shape and pearly white with a pinkish tinge on the legs. A magnifying lens is necessary to see them in detail. They commonly occur in small areas of the field where for unknown reasons the populations have become heavy.

After the seedlings emerge from the muck, the mites congregate at the base of the plants and sever the roots, causing the plants to fall over as if attacked by damping-off. The stand is severly thinned, leaving here and there isolated plants. Later in the season the mites attack the roots of the remaining plants at the basal plates. The bulbs fail to enlarge and the yields, in heavily infested areas, are practically nil.

Control Measures for Nematodes and Mites

Crop Rotation:

Bloat is easily controlled by rotating onions with crops that are not a host to *Ditylenchus dipsaci,* such as lettuce, carrots, potatoes, spinach, and indeed all other vegetables except perhaps garlic. One year of such a crop is not always enough if bloat has become well established, but two years of lettuce or potato growing will eliminate it.

Root knot is harder to control by rotation because there are so many host plants (over 1500) which this nematode can attack. Corn and other cereals are pretty safe but not often economical for an onion grower. An early crop of spinach or lettuce is sometimes satisfactory on infested muck because the plants can attain a fairly good root system while the soil is still too cool (below 60°F.) to induce nematode activity. Fall crops of lettuce, sown in mid-season, suffer the most.

The value of rotation for control of mites has not been established but it might be worth trying.

Soil Fumigation:

Injection of fumigating materials in infested muck has been effective in controlling nematodes and mites. Either of two materials may be used—DD mixture or Telone. Bromine containing fumigants such as ethylene dibromide, EDB, or Dorlone stunt onions and should be avoided where this crop is to be planted. Fumigation is

done in late summer or fall while soil temperatures are 60°F. or above. A single application of 50 gallons fumigant per acre has been effective against "bloat" nematodes in five tests. The root knot nematode is easier to control and the dosage may be reduced to 30 to 40 gallons per acre. Manufacturers of the fumigants give detailed instructions on the use of equipment for application. Growers may procure the equipment to mount on a tractor at a nominal cost, or hire a custom operator who has the proper equipment and experience.

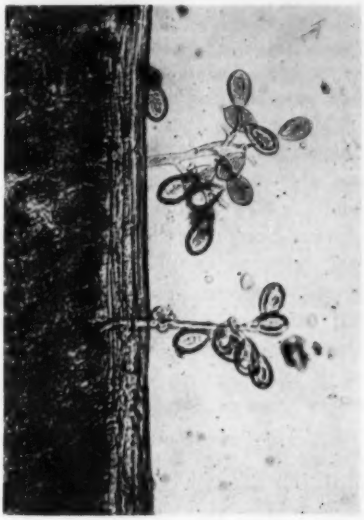
Although extensive experiments have not been made with fumigants to control mites, limited knowledge indicates that the application of 30 to 40 gallons per acre is sufficient to eliminate the trouble. Smut and maggots are not adequately controlled by fumigation of soil with DD, Dorlone, Telone or EDB.

DISEASES AND INSECTS THAT DAMAGE THE FOLIAGE

Mildew

This disease, often called "blight," is caused by a fungus, *Peronospora destructor*. The fungus overwinters in clumps of perennial or "top set" onions, commonly found until a few years ago in backyard gardens. With the start of growth in the spring the fungus invades the leaves of these onions, then produces an abundance of spores throughout the season. These spores are carried by the wind to onion fields nearby. In seasons with frequent fogs and rains, infections on the commercial crop start in May and June, early enough to cause heavy losses in production. The disease may appear earlier on onions grown from sets because a larger leaf area is exposed to the wind-borne spores.

Local campaigns to eradicate the garden plantings of perennial onions within a mile of onion fields have been very successful in reducing losses from



The fungus Peronospora destructor has been magnified to show how the spores are borne and easily carried by air. These begin to form in late April on many backyard plantings of perennial onions.

The way mildew often started in a field in July and spread quickly was one of the disheartening things about onion growing. Now that adequate control materials and methods have been developed, it need not happen here.

mildew. The fungus is not seed-borne nor does it remain in the soil overwinter in New York State.

After spores from the perennial "top sets" settle on the onion leaves, they germinate and the fungus invades the leaf tissues. Then a large, pale, dull area develops on the upper portions of the older leaves. Within a day or two a green or purplish mold grows out of the diseased areas. Often the tips of the leaves wilt and fall over. Spread of mildew is rapid from the original small areas of infection; soon the entire field turns to a dull yellowish green as the diseased tops shrivel and die.

As many as 100,000 spores may be produced on one square inch of moldy leaf tissue. Spores are caught by the wind and probably carried for miles. During July and August spores have been taken in traps fastened to an airplane flying as high as 1500 feet over diseased onion fields. The fungus can spread without rain during cool periods of heavy dews. Spores are formed until frost. Hot dry periods with hot nights for a week or two can put a sudden stop to the disease.

Blast

This is a form of leaf blight often confused with mildew. Infected onion tops become spotted and die back from the tips. The purple mold so characteristic of mildew is lacking in blast. The disease is caused by any one of

four species of Botrytis which overwinter in old onion trash and probably in many other ways. One of the fungi, *Botrytis allii,* also causes neck rot of bulbs in storage.

The first symptoms of blast appear as small, water-soaked spots ⅛ to 2 mm wide by 1 to 8 mm long, that turn light tan or white. These spots are caused by spores, wind-borne or splashed by water, which germinate on the outer leaves. As the spores germinate they give off a toxin or poison that kills the cells underneath. The green chlorophyll is destroyed leaving a small bleached area or spot. When the spotting becomes severe the tips of the leaves die back and turn brown.

Onion blast in its second stage of development when the Botrytis fungus is killing the tips and turning some brown.

Six check plots were left in the middle of this 15 acre field. Seven applications of spray on the remainder of the field increased the yield 40%. Blast was the chief disease.

Leaves may wither down to the base. This premature die-back results in smaller bulbs and reduced yields. Necks of the infected onions fail to dry out properly, increasing the chances of infection by neck and bulb rots. The fungus is most active during hot, wet, muggy weather of July and August. Under these favorable conditions a field may be ruined by blast within a few days.

Thrips (Thrips tabaci)

Toward the end of the season onion foliage may become light greyish or silvery in color and dry out very quick-

ly. In the absence of foliage diseases, this condition is the result of the feeding of onion thrips. These insects are small and difficult to observe. The greyish brown adults fly from the foliage at the slightest disturbance. The young are more easily detected in the axils of leaves as small, whitish wingless creatures. Thrips rasp the outer surface of the tissues causing the leaves to turn greyish in color.

Thrips multiply rapidly during hot dry weather. When these conditions prevail early in the season, thrips will stunt the young onion plants and curl the leaves. More often the infestations start at midseason. The onset of infestation cannot be predicted with certainty as weather conditions have such a pronounced effect on thrips populations. Hot, dry weather is favorable to infestation whereas rain or cool temperatures retard buildup. Thrips are a potential threat throughout the onion growing season.

Control of Leaf Blights and Thrips by Sprays or Dusts

Foliage applications of fungicide and insecticides have become a standard practice during the past decade. Spraying or dusting will keep the onion foliage healthy and green for a full season's growth. Yield increases of 20 to 35 per cent have been recorded from experimental plots.

First applications should start in June and continue at 7 to 10 day intervals until close to harvest. Fungicides containing nabam, maneb, zineb give good control of foliage diseases. Captan and Vancide produce fair results. The liquid nabam is used at 2 quarts per acre supplemented with ¾ pound of zinc sulfate. Zineb and maneb are used at 3 pounds per acre. A wetting agent added to the spray at manufacturers directions will insure good coverage. Dusts containing 8 to 10 percent zineb are applied at the usual rate of 35 to 50 pounds per acre.

For thrips control an insecticide must be added to the fungicide. DDT is effective if applied regularly and before the thrips become numerous. Either the wettable powder or emulsifiable solution may be used at rates which apply 1½ pounds of actual DDT per acre. Parathion, 2 pounds 15% wettable powder or 1 quart of emulsifiable, is quick to kill but is not long lasting. Heptachlor and dieldrin are very effective, act fast, and have long residual effect. A half pound of actual chemical per acre is recommended. Dusts of these insecticides should contain: DDT 5%, or parathion 1%, or heptachlor or dieldrin 2½%. Insecticide dusts, particularly parathion, are dangerous to health when duster operators are exposed to the dust clouds. *Facial masks to prevent breathing in the dust must be worn during the application.* Read the package labels carefully and be fully informed of the precautions to take in using these insecticides.

Proper attention to control measures will help insure a full yield. Use the table on page 8 and 9 for quick reference.

Cooperative Extension Service, New York State College of Agriculture at Cornell University and the U.S. Department of Agriculture cooperating. In furtherance of Acts of Congress May 8, June 30, 1914. M. C. Bond, Director of Extension, Ithaca, New York.